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[0113] In yet another exemplary embodiment, an offline recommendation system is provided. In an exemplary embodiment, the model server collects input parameters beforehand and trains or builds the model based on the collected input parameters. The input parameters are fixed and do not change on the fly.

[0114] In yet another exemplary embodiment, each arm may be a resource that needs to be shared among competing projects or users. At the time of initial allocation, the properties, characteristics, attributes of the projections and/or users are only partially known but additional information about characteristics, properties and/or attributes of these projects and/or user may be learned with time. Each resource is then considered an arm and allocation of these resources are determined by the model server such that utilization of each resource is optimized.

[0115] Various modifications and variations are possible for one or more exemplary embodiments described above. For example, a system is provided with flexibility regarding input to the model. The system may be configured or may determine on the fly whether or not to use historical information from the history data database 204 and/or how much of the historical data to use, see operations 2 and 3 of FIG. 2. Because the online system may keep evolving, the historical information in the nearby past provide close influence to the recommendation schemes. However, the out of date historical events may mislead the trend for current recommendation preference. In order to select operation 2 or operation 3, possible A/B test can be performed to determine if there has been a significant change in users' preference, as explained above.

[0116] When the input data is provided, the data can be a batch or can come as individual inputs, as explained above, depending on the updating rule of the system and the need of frequency to a recommendation system. The batch size can have a broad range since LPBoost with column generation algorithm is able to solve linear programming with very large scales.

[0117] In an exemplary embodiment, the LPBoost recommendation engine can be efficiently computed by parallelizing several computations. As shown in FIG. 2, the predicted rewards in the basic learners and the predicted rewards in the LP Boost can use parallel computation, including training different basic learners and use different basic learners to make a reward prediction, and also training LPBoost methods for different arms (parallel via arms) and use LPBoost to predict rewards for different arms in parallel. Thereby, according to an exemplary embodiment, parallelizing these various computations improves computational efficiency.

[0118] The descriptions of the various exemplary embodiments have been presented for purposes of illustration, but are not intended to be exhaustive or limited to the embodiments disclosed.

[0119] Many changes may be apparent to those of ordinary skill in the art without departing from the scope and spirit of the described exemplary embodiments. The terminology used herein was chosen to best explain the principles of exemplary embodiments, the practical application and/or technical improvement over technologies found in the market place or to enable ordinary skill in the art to understand exemplary embodiments disclosed herein.

[0120] In an exemplary embodiment, the online recommendation engine may be implemented on a tangible computer-readable medium. The term "computer-readable medium" as used herein refers to any medium that participates in providing instructions to a processor for execution. A computer readable medium may be, for example, but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. More specific examples (a non-exhaustive list) of the computer readable medium would include the following: an electrical connection having two or more wires, a portable computer diskette such as a floppy disk or a flexible disk, magnetic tape or any other magnetic medium, a hard disk., a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a memory card, any other memory chip or cartridge, an optical fiber, a portable compact disc read-only memory (CD-ROM), any other optical medium, punchcards, papertape, any other physical medium with patterns of holes, or any other medium from which a computer can read or suitable combination of the foregoing.

[0121] In the context of this document, a computer readable medium may be any tangible, non-transitory medium that can contain, or store a program for use by or in connection with an instruction execution system, apparatus, or device.

[0122] Another form is signal medium and may include a propagated data signal with computer readable program code embodied therein, for example, in a base band or as part of a carrier wave. Such a propagated signal may take any of a variety of forms, including, but not limited to, the electro-magnetic, optical, or any suitable combination thereof. The signal medium may include coaxial cables, copper wire and fiber optics, including the wires that comprise data bus. The signal medium may be any medium that is not a computer readable storage medium and that can communicate, propagate, or transport a program for use by or in connection with an instruction execution system, apparatus, or device.

[0123] Program code embodied on a computer readable medium may be transmitted using any appropriate medium, including but not limited to wireless, wire line, optical fiber cable, RF, etc. or any suitable combination of the foregoing.

[0124] Computer program code for carrying out operations for aspects of the exemplary embodiments may be written in one or more programming languages. The program code may be executed on a user terminal device and on a remote computer or server. The remote server may be connected to the user terminal device through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider).

[0125] The computer-readable medium is just one example of a machine-readable medium, which may carry instructions for implementing any of the methods and/or techniques described herein. Such a medium may take many forms, including but not limited to, non-volatile media and volatile media. Non-volatile media includes, for example, optical or magnetic disks. Volatile media includes dynamic memory.

[0126] Various forms of computer readable media may be involved in carrying one or more sequences of one or more instructions to a processor such as a CPU for execution. For example, the instructions may initially be carried on a magnetic disk from a remote computer. Alternatively, a